

1984

TOBACCO PRODUCTION RECOMMENDATIONS



Ministry of
Agriculture
and Food

ONTARIO

Dennis Timbrell

Minister

SUCKER CONTROL

FERTILIZATION AND
SOIL MANAGEMENT

CULTURAL
PRACTICES

SEEDLING
PRODUCTION

Pesticide products listed in this publication have been reviewed by the Ontario Pesticide Advisory Committee and have been classified under the Pesticides Act.

EMERGENCY PROCEDURE FOR PESTICIDE POISONING

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water for 15 minutes.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL, TAKING THE LABELLED PESTICIDE CONTAINER WITH YOU.

First-aid Information The Occupational Health and Safety Division, Ministry of Labour, 400 University Ave., Toronto, M7A 1T7, has physicians available for consultation on first-aid information and advice. They can be contacted in the following manner:

Between the hours of 8:00 a.m. and 5:00 p.m.
Monday to Friday, telephone - (416) 965-3610

During weekends, public holidays and non-office hours telephone - (416) 965-1211 and ask for the "on-call" physician.

The recommendations in this publication are for the 1984 season and may be revised whenever further information is available. **Discard old editions.**

All recommendations in this publication are stated in metric units. Amounts of materials recommended for field application are for one hectare (ha) while greenhouse treatments are expressed in amounts per 100 square metres (100 m²). Refer to pages 43 to 48 for conversion factors and metric equivalents.

Assistance with problems regarding tobacco production may be obtained by contacting:

- (a) Burley Tobacco
Clem Fisher, Research Station, Harrow, N0R 1G0 (519) 738-2251
- (b) Flue-Cured Tobacco
Norm Sheidow or Milt Watson, Research Station, Delhi, N4B 2W9 (519) 582-1950

Agri-Phone - (519) 582-1713

The Ontario Ministry of Agriculture and Food maintains an Agri-phone at the Research Station, Delhi. Agri-phone messages, updated three times a week, are available throughout the growing season.

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PRECAUTIONS WITH PESTICIDES

1. Always read the label before opening pesticide containers, and follow all precautions and directions.
2. Never smoke, chew tobacco or eat while handling or applying pesticides. DO NOT carry such items in clothes used for spraying.
3. Always wear neoprene gloves to handle the concentrate. Wear a mask to reduce pesticide inhalation, especially when handling dusty formulations or volatile concentrates. Avoid inhaling spray droplets, dust or fumes by wearing a mask.
4. Avoid spilling pesticides on skin or clothing.
5. Wear freshly laundered clothes each day.
6. When filling or flushing spray equipment, avoid contamination with pesticides of water supplies, wells, ponds, streams, etc. Never fill a sprayer directly from a stream or pond, unless the unit is equipped with an anti-backflow device to prevent siphoning.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing immediately, and wash contaminated skin thoroughly with soap and water. Wash clothing before reuse.
2. If clothing becomes wet with a pesticide when spraying, remove it immediately. When the spray operation is complete; remove contaminated clothes, have a bath or shower and put on freshly laundered clothing.
3. Clean up any pesticide spills immediately. Use dry soil, sawdust or other absorbent material to remove excess liquid. If the spill is major, contact the nearest office of the Pesticide Control Service for advice (see list pages 42 and 43).
4. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to hospital immediately. If possible, take a labelled container of the pesticide with you. (See **Emergency Procedures for Pesticide Poisoning**, Inside Front cover).
5. If a well becomes contaminated, follow clean up instruction in factsheet *Pesticide Contamination of Farm Water Supplies* Order No. 80-025, Agdex 607.

SPECIAL INSTRUCTIONS

It should be emphasized that all pesticides are toxic and must be handled safely. In addition, a number of pesticides (insecticides, fungicides and herbicides) have major deficiencies in their toxicological information because of the many tests that were conducted by the Industrial Biotest Laboratory (IBT), some of which were invalid. Replacement studies are currently being conducted by the respective registrants. Those handling and applying these chemicals must pay special attention to the precautions outlined above.

At the time of publication, pesticides included in *1984 Tobacco Production Recommendations* requiring additional studies are as follows:

CSA COMMON NAME

TRADE NAME

acephate
oxydemeton-methyl

Orthene
Metasystox-R

STORAGE

1. General Storage

The Ontario Pesticides Act and Regulation 751 requires that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food for humans and feed for animals.

Herbicides should be stored separately from other pesticides to avoid possible contamination.

Special Storage

Schedule 1, 2 and 5 - pesticides must be stored in a storage facility which is ventilated to the outside atmosphere. A placard bearing the words "**CHEMICAL STORAGE WARNING - AUTHORIZED PERSONNEL ONLY**" in block capitals must be affixed to the outside of each entrance. Entry to the storage facility should only be made by the person responsible for the pesticide or with his permission.

2. Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers. See also OMAF Factsheet, *Farm Storage of Pesticides*, Agdex 607.
3. Post pesticide storage areas with proper notices.
4. In areas where flooding has been a frequent occurrence, fertilizers and pesticides must be stored above the known high water mark to avoid contamination of the flood waters. Contamination of water by these chemicals can and has led to serious health problems, affecting humans, domestic animals as well as fish and wildlife.

DISPOSAL OF PESTICIDE CONTAINERS AND CONTAMINATED MATERIAL

1. Containers from pesticide packages and any paper or other material used to clean up spills should be buried or burned. Make sure that people and animals are kept away from the smoke and that the smoke is not directed toward buildings, highways, roads, or outdoor areas frequented by the public.
2. Un-rinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful - why not use that 3% for the purpose for which it was purchased, i.e., to control the pest!

Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residual left in the container directly into the spray tank. This procedure takes less than a minute. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

PROTECTIVE CLOTHING WHEN USING PESTICIDES OUTDOORS

1. When measuring and mixing pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, and protective eyeshields.
2. Disposable gloves, aprons, overalls and hat covers are available at reasonable prices from the major safety supply companies.
3. Wash all clothing after use.
4. Wear a chemical respirator with dual cartridges when mixing and applying pesticides. Consult the following chart for proper selection. Never interchange components.

TABLE 1. DUAL CHEMICAL CARTRIDGE RESPIRATORS RECOMMENDED FOR OUTDOOR PROTECTION FROM PESTICIDES (Listed in Numerical Order According to NIOSH Approval Numbers)

NIOSH Approval Number	Approval Issued to	Respirator No. and Description	Component Numbers	Available From
TC-23C-54	Willson	122115 (2 sizes) Half Face	R21 Cartridges R15 Filters	Safety Supply Canada Toronto
TC-23C-74	Norton	7549L 7549M 7549S (3 sizes) Half Face	N7500-21 Cartridges N7500-23 Filters N750-27 Filter Cover	Siebe-Norton Inc. Toronto, Ontario
TC-23C-78	3M	Powered Air Purifier (pesticide) White Cap Helmet Full-face	Cartridges Filters and Hood and Vest Kit	Safety Supply Co., Canada Toronto
TC-23C-106	American Optical	R4058 R5058 R6058 Half Face (3 sizes)	R58A Filter/ Cartridges	AO Safety Products Div., of AOCO, Toronto
TC-23C-117	Scott	Scott Respirator 64-OVP Half-face (3 sizes)	642-OV Cartridges 642-F Filters	Safety Supply Co., Canada Toronto
TC-23C-123	3M	8751 Half Face	Pre-filter 8752 Retainer 3733	Safety Supply Canada Toronto
TC-23C-124	Safety House	236-G100 F-104 Half face	G100 Cartridges F104 Filters	Safety House of Canada, Toronto
TC-23C-133	Wilson	162115 172115 Full Face	R15 Filters R21 OV Cartridges	Safety Supply Canada Toronto

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NIOSH Approval Number	Approval Issued to	Respirator No. and Description	Component Numbers	Available From
TC-23C-148	MSA	460560 (3 sizes) Full-face	464025 Combination Cartridges	MSA of Canada, Downsview
TC-23C-178	Norton	75BP 49L 75BP 49M (2 sizes) Full Face	N-7500-21 Cartridges N-7500-23 Filters back-pack	Siebe-Norton Inc. Toronto, Ont.
TC-23C-190	Norton	7649L 7649M 7649S Full Face (3 sizes)	N-7500-21 Cartridges N-7500-23 Filters	Siebe-Norton Inc. Toronto, Ont.
TC-23C-202	H.S. Cover (York)	Myl 1482 G	100 Cartridges 104 Filters	Levitt-Safety, Ltd., Toronto
TC-23C-224	Scott	Scott Respirator 65-OVP Full-face (2 sizes)	642-OV Cartridges 642-F Filters	Safety Supply Co., Toronto Canada
TC-23C-238	American Optical	R7058 Full-face	R58A Filter/ Cartridges	AO Safety Products Div., of AOCO, Toronto
TC-23C-281	American Optical	R4563 R5563 R6563 (3 sizes)	R563A Filter Cartridges	AO Safety Products Div., of AOCO, Toronto
TC-23C-282	American Optical	R7563 Full-face	R563A Filter Cartridges	AO Safety Products Div., of AOCO, Toronto
TC-23C-323	Survivair	2131-00 2231-00 2331-00 (3 sizes)	1001-00 Cartridge 1030-00 Filters	Levitt-Safety Ltd., Toronto

TABLE 1. DUAL CHEMICAL CARTRIDGE RESPIRATORS RECOMMENDED FOR OUTDOOR PROTECTION FROM PESTICIDES (Listed in Numerical Order According to NIOSH Approval Numbers)

NIOSH Approval Number	Approval Issued to	Respirator No. and Description	Component Numbers	Available From
TC-23C-374	Willson	3021155 Breathing Assist Respirator	R15 Filters R21 OV Cartridges	Safety Supply Canada Toronto
TC-23C-375	Willson	322115 Breathing Assist Respirator	R15 Filters R21 OV Cartridges	Safety Supply Canada Toronto

Additional information on protective equipment may be found in *Personal Protective Equipment for Pesticide Users*, available at offices of the Pesticide Control Service, your pesticide dealer, and offices of the Ontario Ministry of Agriculture and Food.

PROTECTIVE CLOTHING WHEN USING PESTICIDES IN GREENHOUSES AND OTHER ENCLOSED AREAS

Respiratory Protection - Available Devices

Air-Purifying Devices - Canister Gas Masks

Canister gas masks have been used effectively for many years by greenhouse applicators for respiratory protection against certain gases, vapours and particulate matter which otherwise might be harmful to life or health.

From a practical standpoint, canister gas masks are generally suitable for ventilated areas not subject to rapid change, but should never be used in confined spaces where oxygen deficiency and high gas concentrations may occur.

Self-Contained Breathing Apparatus

Self-contained breathing apparatus approved by NIOSH (U.S. National Institute of Occupational Safety and Health) is the only apparatus recommended for respiratory protection in enclosed places where oxygen-deficiency with high gas concentrations occur.

Working Conditions

High Concentrations

- (a) Use only a self-contained breathing apparatus e.g. Scott, Air Pak.
- (b) High concentration of toxic gases, vapors or particulate matter can be produced when dispensing extremely or highly toxic pesticides such as parathion, nicotine and naled (Dibrom):
 - (i) through fogging machines
 - (ii) by means of smoke bombs
 - (iii) as spray applications.

In such instances self-contained breathing apparatus is recommended.

Low Concentrations

Canister gas masks may be used when the ambient air contains low concentrations of toxic gases, vapors or particulate matter derived from soil drench, granular dust, or foliar spray applications. Pesticides applied in such manner are usually of moderate to low toxicity. The exceptions include aldicarb (Temik 10G) and fensulfothion (Dasanit 15G) but the wearing of canister gas masks provides protection.

Contact your safety supply company for the proper canister selection.

Other Clothing

When measuring, mixing and applying pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, hat, and protective eyeshields or a full-face mask.

RELATIVE TOXICITIES OF PESTICIDES RECOMMENDED ON TOBACCO

Extremely toxic - Guthion (azinphos-methyl); Phosdrin (mevinphos); Lannate (methomyl).

These pesticides are dangerous if inhaled, swallowed, or allowed to contact skin. A few grams can be fatal. Wear protective clothing (page 3), avoid mixing in windy areas, dispose of containers properly (page 3) and always change clothing and wash immediately after use.

Moderately toxic - Basudin (diazinon); Diazinon; D-D; lindane; Lorsban (chlorpyrifos); Telone II; Telone C-17; Vorlex; Pirimor (pirimicarb); Vorlex CP; Ripcord (cypermethrin); Decis (delta methrin)

These pesticides are dangerous if handled carelessly. Caution is required to insure that they are not taken internally or allowed to contact skin. Wear protective clothing including respirator and goggles when mixing or working with them. Avoid breathing the vapors. Remove clothing and wash after applying these pesticides. Triple rinse and dispose of containers properly (page 3).

Pesticides listed in this calendar and not appearing on this list have lower toxicities and should be handled with all precautions listed on the label. Even the most toxic pesticides can be used safely, if used properly, by following all directions and precautions listed on the label.

RE-ENTRY TO TREATED AREAS

Pesticide poisoning may occur where workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide vapors.

The pesticides listed below are those for which a specific minimum interval must be observed from the time of application to the time of working in the crop. For some pesticides, e.g., parathion, the label carries a warning regarding working in treated crops. Follow these recommendations. Where no label warnings are provided, minimum intervals recommended for re-entry are 24 hours for Lannate and 48 hours for Phosdrin, Guthion and Metasystox-R.

PESTICIDE DRIFT

Pesticide drift can leave unwanted residues on adjacent crops, be a hazard to people and livestock nearby or reduce the amount of material in the target area as to be ineffective.

Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by paying attention to:

1. correct calibration and maintenance of spray equipment;
2. correct operation of the equipment;
3. the toxicity of the pesticide in use; and
4. the weather conditions.

For more information consult OMAF Factsheet *Pesticide Drift*, Agdex 607 or Canadex 607, *Pesticides: effects of drift and droplet size*.

APPLICATION BY AIRPLANE OR HELICOPTER

Aerial applicators must be licenced by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of the Pesticides Act for the application of Schedule 1 and 5 pesticides and Schedule 2 hormone-type herbicides. The area will be inspected by Ministry personnel to ensure safety of application.

It is an offence under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, e.g., Sevin (carbaryl).

Applications should not be made if the wind is blowing. Some drift occurs even on the stillest day and to keep it to a minimum, apply pesticides in the evening or early morning.

Be sure that the product to be used is specified, along with rate of application, in the contract.

PESTICIDE RESISTANCE

Many of the pesticides recommended have a very specific mechanism of action, that is, they act on a single system or site in the organism. These materials should not be used continuously and repeatedly in a season-long program since this will increase the chances of the development of pest resistance. An example of this type of compound is Benlate.

In our recommendations we suggest that such compounds be used in combination with other pesticides or that they be alternated with other pesticides so that the likelihood of resistance development is reduced.

ABBREVIATIONS

EC = emulsifiable concentrate
SC = spray concentrate
WP = wettable powder
SP = soluble powder
F = flowable
G = granules
°C = degrees Celsius
% = percent (by weight)

kg = kilogram
g = gram
ha = hectare
m = metre
cm = centimetre
mm = millimetre
L = litre
mL = millilitre



All pesticide products are registered by Agriculture Canada. No pesticide may be used on any crop for which it is not registered. Such use can result in seizure of the crop.

POLICY STATEMENT

In this publication most recommendations list several pesticides that are effective for each insect or disease discussed. Where possible, the less hazardous materials and those that growers have used satisfactorily for a number of years are listed first. These are followed by the toxic pesticides and/or newer ones with which we have less experience. It must be emphasized that in some cases the most effective pesticides are highly toxic.

The effectiveness of pesticides, and plant injury by control chemicals, are influenced by the weather and other conditions. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powder (WP and SP) preparations generally are less likely to cause plant injury than liquid concentrate (EC, SC, and F) formulations.

PESTICIDE RESIDUES

To minimize or eliminate pesticide residue in cured tobacco:

1. Observe the specified interval between foliar treatment and harvest as indicated in brackets following the recommendation.
2. Do not apply more than the recommended amount.
3. Do not apply more often than recommended on the label.

For example, Ambush 500 EC, 140 mL/ha (55 days) indicates that Ambush should not be used later than 55 days before the treated tobacco is harvested, and no more than 140 mL of the 500 EC formulation should be used for one hectare of crop in an application.

NOTE: Recommendations in this publication refer to both flue-cured and burley tobaccos unless otherwise indicated.

INSECT CONTROL

Observe the specified interval between foliar treatment and harvest as indicated in brackets following the recommendation.

CUTWORMS

(a) Greenhouse

When damage appears, spray the plants in the evening with one of the following per 100 m² of seedbed area in 15 L of water:

- Ripcord 40 EC - 3 mL (about 1/2 teaspoonful)
- Ambush 500 EC - 2.5 mL (1/2 teaspoonful)
- Dylox 80% SP - 45 g

Treatment with Ripcord and Ambush for cutworm control has been observed to provide some reduction of ants and grasshoppers.

(b) Field

Use one of the following three alternatives. Apply materials during late afternoon or in the evening using at least 220 L/ha of water. Cutworms may migrate to tobacco fields from bordering areas. Use Lorsban, Ambush, Ripcord or Decis to treat these areas according to label directions and precautions.

- (1) Cover crop -
 - Lorsban 4C - 1.4 L/ha
 - Ambush 500 EC - 140 mL/ha
 - Ripcord 40 EC - 90 mL/ha
 - Decis 2.5 EC - 200 mL/ha

Treatment of the cover crop is most effective when applied soon after the cutworms have hatched. Application can usually be made in mid-to-late-April. When the cover crop is 10-15 cm high the cutworms will be at the right stage for best control. Treat 4 to 5 days before plowing.

- (2) Soil -
Lorsban 4C - 2.8 to 5.6 L/ha
Ambush 500 EC - 140 to 275 mL/ha
Ripcord 40 EC - 175 to 350 mL/ha
Decis 2.5 EC - 400 to 800 mL/ha

These materials work best when the soil is moist. Use the higher rates when the top 2 cm or more of soil is dry. Treat 1 to 3 weeks before planting, and preferably before mid-May.

The soil should not be disturbed for at least 5 days after applying Ambush, Ripcord and Decis since mixing with the soil will reduce the effectiveness of these materials.

Lorsban is preferably left on the soil surface although very shallow incorporation (2 to 3 cm) is not likely to reduce its effectiveness. However, deep incorporation may lower the activity of Lorsban.

- (3) After Planting -
Ambush 500 EC - 140 mL/ha (55 days)
Ripcord 40 EC - 175 mL/ha (60 days)
Orthene 75% SP - 1.50 kg/ha (3 days)
Decis 2.5 EC - 400 mL/ha (70 days)

This treatment may also be used if pre-planting treatments fail to provide control. Treat when 5% or more of the young seedlings show signs of cutworm feeding.

NOTE: For cutworm control late in the season, i.e., during late June and July, use only Orthene because the treatment to harvest intervals established for Ambush (55 days), Ripcord (60 days) and Decis (70 days) permit use of these materials only during a short period of time after planting.

WIREWORMS

Use one of the following amounts of insecticide per 180 L of planting water:

- Lindane 25% WP - 28 g
Benesan 50% WP - 14 g

Apply 170 mL of the mixture per plant. With 107 x 61 cm spacing, 2600 L/ha would be required.

Stir mixture frequently to reduce settling and drain the barrel occasionally to avoid over-concentration of the insecticide. Lindane may be used in combination with Basudin in the planting water.

SEED MAGGOTS

Well hardened, sturdy transplants are less apt to be retarded by maggot feeding. Use one of the following per 180 L of planting water:

- Basudin 50 W or Diazinon 50W - 42 g
Lorsban 25W - 50 g

Apply 170 mL of the mixture per plant. With 107 x 61 cm spacing, 2600 L/ha would be required.

Stir the mixture frequently to reduce settling and drain barrel occasionally to prevent over-concentration of the insecticide. Basudin or Diazinon may be used with Lindane or Benesan in the planting water.

CAUTION:

1. Do not combine Lorsban with Lindane or Benesan in the planting water.
2. Do not combine Basudin, Diazinon or Lorsban with starter fertilizer in the planting water.
3. Band treatments of granular fertilizer should be placed 10 cm on each side of the tobacco row. Closer placement, in combination with Basudin, Diazinon or Lorsban in planting water, may injure tobacco plants.
4. Avoid contact with planting water containing Lindane, Benesan, Basudin, Diazinon or Lorsban.

TARNISHED PLANT BUGS

Tarnished plant bugs occasionally infest tobacco fields during July. They feed on the leaves and injure the leaf midrib, causing the end of the leaf to wilt or break.

Use the following:

Dylox 80% SP - 1.50 kg/ha (3 days)

HORNWORMS

Treatment is justified when the population averages 5 or more hornworms per 100 plants.

If the above population occurs, use one of the following in sufficient water to provide adequate coverage; repeat if necessary.

1. Dipel, 275 g/ha (0 days)
2. Thuricide HPC, 1 L/ha (0 days)
3. Orthene 75% SP, 725 g/ha (3 days)
4. Dylox 80% SP, 1.50 kg/ha (3 days)
5. Sevin 50% WP, 2.25 kg; 80% WP, 1.50 kg; 85% WP, 1.25 kg/ha (3 days)
6. Lannate Liquid, 2.25 L/ha (5 days). *Minimum period before entering fields treated with Lannate is 24 hours.*

Ground or aircraft applications are equally effective. Do not work in tobacco fields during application of chemical insecticides. Observe the recommended interval between treatment and harvest.

Tobacco treated with Thuricide HPC or Dipel can be handled immediately after treatment as these materials are not poisonous to man or animal.

NOTE: Hornworms stop eating immediately after feeding on tobacco treated with Thuricide HPC or Dipel. The larvae may remain alive but not feeding up to 6 days after treatment.

APHIDS**Seedbeds**

If aphids are present, use the following per 100 m² of bed at least 5 days before first plants are to be pulled; repeat if necessary.

Malathion 25% WP - 30 g per 12 L of water applied at 12 to 24 L, depending on size of plants.

Field

Treat especially the undersides of the leaves with one of the following when at least 20% of the plants have 5 or more groups of aphids on each upper leaf:

1. Pirimor 50 W, 275 to 550 g/ha (14 days)

2. Metasystox-R, 1.25 L/ha (14 days) (flue-cured only). *Minimum period before entering fields treated with Metasystox-R is 48 hours.*
3. Orthene 75% SP, 725 g/ha (3 days)
4. Lannate Liquid, 2.25 L/ha (5 days). *Minimum period before entering fields treated with Lannate is 24 hours.*
5. Guthion 240 SC, 3.50 L/ha or 50% WP, 1.7 kg/ha (6 days). *Minimum period before entering fields treated with Guthion is 48 hours.*
6. Malathion 50% EC, 2.00 L/ha (7 days)
7. Phosdrin 100% liquid, 150 mL/ha (3 days). *Minimum period before entering fields treated with Phosdrin is 24 hours.*

NOTE:

1. Thorough spray coverage of the upper part of the plant, where aphids are normally found, is essential to obtaining good control. Follow label directions for nozzle arrangements and spray volumes.
2. Malathion is not effective at temperatures below 18°C.
3. Application of non-systemic insecticides by aircraft for aphid control may not be as effective as ground application because of inadequate underleaf coverage.

FLEA BEETLES

These small, shiny, black jumping beetles chew small holes in the lower leaves. If high populations are present, use one of the following:

Sevin 50% WP, 2.25 kg; 80% WP, 1.50 kg; 85% WP, 1.25 kg/ha (3 days)
 Orthene 75% SP, 725 g/ha (3 days)

NOTE: These insects seldom cause sufficient damage to warrant treatment.

WARNING

Avoid inhaling pesticide dust or spray.

DISEASE CONTROL

For additional information on diseases affecting tobacco refer to Agriculture Canada Publication 1641, *Tobacco Diseases*.

SEEDBED STERILIZATION

Thorough sterilization is necessary to rid the seedbed of weeds, soilborne diseases and nematodes.

Steaming - Steaming is considered to be the most consistent and reliable method of sterilization, provided the soil is in proper condition and sufficient time is taken to obtain the required temperature.

Steaming may be done in the fall or spring. Conditions in the fall are likely to be more favorable for thorough steaming than in the spring when frozen soil is often a problem. Fall steaming also has the advantage of allowing time for the recovery of soil micro-organisms,

some of which may compete with damping-off fungi, reducing their spread and development. One disadvantage of steaming in the fall is the possible reinfestation of the seedbed with weedseeds and diseases due to glass breakage during the winter.

The usual method is to inject steam under a metal pan although large plastic sheets are being used in a few cases. To provide optimum conditions for steam penetration, the seedbed should be uniformly loose with just enough moisture for the germination of seeds.

For thorough sterilization with steam, a temperature of 82°C held for 30 minutes at a 15 cm depth is required. These requirements will normally be met by steaming under pans for half an hour. Three to five hours may be required when plastic is used, depending mainly on soil condition, type of steamer, and size of plastic. A soil thermometer should be used to determine the required steaming time.

Fumigation - The chemicals Basamid, Mylone, Vorlex and Vapam may be used as alternatives to steaming. These materials must be applied in the fall preferably before the end of October. Late fall or spring application, is likely to result in damage to germinating tobacco seed and young seedlings.

Acceptable control of weeds, most fungi and nematodes is usually obtained with these chemicals. However, there has been some variation in effectiveness in controlling the fungus disease black root rot which can be a serious problem in the seedbed. Thorough steaming is the most reliable means of controlling black root rot.

Having the seedbed prepared and thoroughly moistened at least a week before treatment is essential in obtaining good results. Sufficient moisture for seed germination must be maintained in the seedbed during the 7 or more days before treatment. Excess moisture should be avoided during this period.

The following amounts of material are for 100 m² of seedbed area:

Basamid - 3.25 to 5 kg

Mylone - 6.5 kg

Vorlex - 6 L

Vapam - 10 L in 800 L of water

Consult product labels for further information on the proper application of these materials.

Treatment of Walls, Walks and Boards - Disease organisms, harbored on walls, walks and boards, may contaminate the sterilized seedbed. A formaldehyde solution (1 L of formalin to 25 L of water) applied to these areas after steaming, and 4 to 5 days before seeding, has proven effective in reducing seedling diseases, particularly those causing damping-off. It is preferable to apply the solution on a warm day. After the solution has been applied, the greenhouse should be closed for 2 days and then opened for at least 2 days before seeding, to allow injurious fumes to escape.

CAUTION - Avoid drenching areas of the seedbed with the formaldehyde solution. Damage to germination and seedling growth may occur where the seedbed is drenched with formaldehyde 4 to 5 days before seeding.

DAMPING-OFF (BED ROT)

Damping-off is caused by organisms (mainly Rhizoctonia and partly Pythium) present in most soils. It may affect very young seedlings just as they are emerging, causing the plants to shrivel and die. Later occurrence of the same disease may be indicated by a wet rot which develops where plant stems and leaves decay at the ground surface. The disease is often found in patches throughout the seedbed, and is usually most serious where there is a thick stand of plants. In most cases recontamination of the sterilized seedbed is the main cause of the disease. Conditions such as humid atmosphere, wet seedbed soil, and thick stands of seedlings, favor development of damping-off.

Control

The prevention or control of damping-off depends on a combination of good greenhouse management and the proper use of fungicides. Apply the following per 100 m² when damping-off first appears.

Benlate 50W at 125 g in 250 to 350 L of water. Repeat if necessary.

NOTE: Benlate provides good control of the more common *Rhizoctonia* type of damping-off.

The following management procedures will help in the prevention and control of damping-off:

1. Before sterilizing, loosen the seedbed to promote good drainage.
2. Thoroughly sterilize the soil.
3. Surface sterilize shoes and tools before walking and working in a sterilized seedbed. Use a formaldehyde solution mixed 1 to 25, formalin to water.
4. Treat walls and walkways with a formaldehyde solution. (See **Seedbed Sterilization**.)
5. Use the recommended seeding rates.
6. After the plants cover the seedbed, do not water in the afternoon.
7. Ventilate as much as possible.
8. Aim to have the seedbed surface as dry as possible by evening.

BLACK ROOT ROT (Seedbed)

The disease is found where the soil has not been properly sterilized. Usually small areas of the seedbed are affected. Diseased plants transplanted to the field will be very slow to start growing.

Control

Thorough sterilization will control this disease in the seedbed. Avoid deep working of the seedbed after sterilization.

YELLOW PATCH

Characteristic symptoms of yellow patch are irregular patches of yellow, stunted plants in the seedbed. Roots of affected seedlings exhibit various degrees of discoloration and rotting. In severe cases affected seedlings die; in milder cases new rootlets develop above the rotted ones and the plants may recover.

Control

This trouble is caused mainly by excessive fertilization of the bed before sowing and can usually be prevented by following the fertilizer recommendations. If yellow patch develops, some relief can be obtained by allowing the soil to dry out thoroughly for about 2 days and then watering heavily to leach out some of the excess fertilizer. (See page 22, under **Seedbed Fertilization**.) Excessive compaction of the seedbed soil tends to aggravate this condition.

2,4-D INJURY

Symptoms vary depending on the amount of 2,4-D to which the plants are exposed. Usually the most obvious symptom is extreme leaf distortion. Affected leaves droop, are narrow and often more or less strap-shaped with very prominent veins and wavy or deeply-toothed margins and, in many cases, the surface is blistered. In mild cases the plants may recover, but in severe instances there is no recovery from the damage.

Control

Tobacco plants are very sensitive even to small amounts of 2,4-D. Any sprayer or other equipment that has been used for 2,4-D application should **never** be used on tobacco. Spraying with 2,4-D should not be done near tobacco beds or tobacco fields because there is always danger of spray or vapor drifting.

ATRAZINE DAMAGE

When this material is present in the seedbed, at or soon after seeding, plants will emerge but they soon dry up and disappear. When applied to larger plants in the seedbed, atrazine causes a yellowing of the leaves, especially the tips and margins and, depending on amount, death of the leaf or entire plant may occur.

Symptoms of Bladex and other triazine herbicides are similar to atrazine.

Control

Sprayers or parts of spray equipment that have been used to apply atrazine or other triazine herbicides should never be used to spray tobacco. Be careful not to contaminate water supplies and never fill the herbicide sprayer near the greenhouse.

BLUE MOLD

(a) **Seedbed** On small seedlings the first leaves lose their normal green color and a grey to bluish mold develops. Larger seedlings show a more pronounced yellowing and often wilt slightly. Affected seedlings are unsuitable for transplanting as they remain stunted and the brittle stems are easily broken by wind.

(b) **Field** Infected leaves initially show large yellow spots with greyish-blue mold on the undersurfaces. As these spots age they become brown and the dead tissue eventually drops out either in the field or during curing.

Control

(a) **Seedbed** - Steam sterilization of the seedbed and treatment of the walls and walkways with a formaldehyde solution as described under Seedbed Sterilization are recommended to destroy any blue mold contamination in the greenhouse.

Apply Ridomil 240 EC at 50 mL in 100 L of water per 100 m² of seedbed within a period of 3 days before seeding.

(b) **Field** - Registered preventive measures as approved by the Blue Mold Task Force will be recommended according to label directions.

FIELD STUNTING OF TOBACCO

Root lesion nematodes and black root rot are the main causes of stunting in Ontario. Occasionally a combination of both diseases may occur or a third factor, as yet undefined, may be involved.

Nematodes Nematodes are most likely to occur in sufficiently high populations to cause stunting on the well-drained medium to light tobacco soils. The main characteristic of nematode damage in the field is the appearance, in late June or early July, of patches of stunted plants which tend to wilt, particularly during mid-day. Root systems are usually quite small and brown areas may be seen on the roots. In severe cases, the plants remain stunted throughout the season, and the yield will be greatly reduced. In milder cases, the affected plants may recover by mid-summer, but such plants are late in maturing.

Black Root Rot This disease is more prevalent on the heavy or poorly-drained tobacco soils, and during cool wet seasons. Damage is usually more severe where there is a crop sequence of tobacco following tobacco. Under severe conditions, plants are stunted early in the season, and their maturity is delayed, resulting in a reduction of yield and quality of tobacco. Crop losses are seldom high where varieties with high tolerance to black root rot are used.

A satisfactory crop rotation such as rye-tobacco or wheat-tobacco should be practiced to help prevent the buildup of black root rot in the soil. For flue-cured tobacco on heavy or poorly-

drained soils, a corn-tobacco rotation may prove beneficial in reducing black root rot. Varieties are now available which have a high degree of tolerance to this disease. Of the flue-cured tobacco varieties, Delhi 76, Nordel and Delgold are the most tolerant, followed by Virginia 115, Candel and Newdel (pages 32 and 33). The burley varieties, Burley 1 and Harwin, have shown tolerance to the disease.

Control

Several soil fumigants are available to control nematodes and aid in reducing damage from black root rot. These materials must be injected into the soil about 15 cm deep in the spring about 3 weeks before planting.

Where nematodes are considered to be the main problem use one of the following:

TABLE 2.

	Row	L/ha	Broadcast
DD	110		220
Telone II	75 - 90		150 - 180
Vorlex	28 - 40		56 - 80
Vapam	65 - 85		170

NOTE: The rates of DD and lowest rates of Telone II, Vorlex and Vapam are considered the minimum required for nematode control.

Where black root rot, or black root rot along with nematodes, is considered to be a problem, the following treatments will provide satisfactory nematode control and may help in reducing damage from black root rot.

TABLE 3.

	L/ha Row
Telone C-17	75 - 100
Vorlex CP	50 - 80
Vorlex	56 - 90

NOTE: Rate of fumigant application should vary within the recommended ranges according to the likely severity of black root rot considering contributing factors such as field history of previous black root rot, cropping sequence, type of soil and tolerance of variety to be grown.

CAUTION - FUMIGANT DAMAGE: Tobacco plants may be killed or severely stunted if the fumigant has not escaped from the soil before planting. The danger of toxic amounts of fumigant remaining in the soil is greatest in low, poorly-drained areas or in heavy tobacco soil. On these soils, injecting the fumigant to a shallow depth of 10 to 15 cm should help in reducing the risk of damage. Caution should be exercised with any tobacco soil, especially when high rates of fumigant are used and/or cool, wet conditions prevail during the period between fumigating and planting.

Fields should be checked in several places, about a week before transplanting, for odor of the fumigant in the soil near the point of injection. If fumigant odor is detected, where the field has been row fumigated, the hills should be opened, about one week before planting, with a single chisel or cultivator tooth. Re-opening may be necessary if heavy rainfall and cool temperatures occur after the initial opening. Where the fumigant has been broadcast, the soil should be cultivated to the depth of the treatment zone about one week before planting.

SORE SHIN

Each year sore shin affects some plants in fields of tobacco soon after transplanting. Affected plants show brown or black discolored areas on the stem near ground level. The extent of the lesion varies, sometimes being limited to one side or, in severe cases, completely girdling the stem. Some of the affected plants die soon after planting, while others may develop normally until later in the season when they may be broken off by wind.

Control

The disease has been noticed in the field under a wide range of moisture and temperature conditions. This may be attributed to the different strains of the fungus causing sore shin.

There is no chemical recommendation for the control of sore shin.

WEATHER FLECK

Weather fleck, a leaf disorder of flue-cured tobacco, is caused by certain oxidants in the air, mainly ozone. Oxidants damage the leaf tissue and cause the development of small spots that are irregular in shape and generally less than 4 mm in diameter. The spots are initially black, but later turn brown and eventually grayish white. The most serious losses generally occur just before or during the early part of harvest when the lower leaves are maturing.

Control

Present control measures involve cultural practices and varieties.

Certain cultural practices, such as proper spacing (page 35), proper irrigation, well-balanced fertilization, early topping and clean suckering, help to produce a leaf which is less susceptible to weather fleck. For tolerance of varieties, see pages 32 and 33.

FRENCHING

This disease occasionally appears, especially on marginal tobacco land. Severely affected plants are stunted and the leaves become thick and straplike. Sometimes only the suckers are affected.

Control

The tendency to french is definitely related to soil conditions. Improved drainage and good fertilization practices may help in avoiding the disease.

VIRUS DISEASES

(a) **Tobacco Mosaic** - The tobacco mosaic virus appears to be quite variable; consequently, symptoms on affected plants may vary also. The characteristic symptom is leaf mottling with yellow-green and dark green areas. The younger leaves are frequently blistered and malformed. The major damage is reduced yield and quality.

Control

The following preventive measures should be taken:

1. Avoid the use of tobacco while working with seedlings either in seedbeds or during transplanting operations.
2. Tobacco should not follow tobacco or tomatoes in rotation.
3. Transplanting and cultivating machinery used previously for tomatoes should be washed thoroughly.
4. Do not cultivate when plants are wet.
5. Rogue out diseased plants if they show virus symptoms within a few weeks after transplanting.
6. Certain weeds may become infected with mosaic, therefore proper weed control in greenhouses, fields and fencerows is important.

(b) **Tobacco Etch** - This virus disease is established in much of the burley-growing acreage in the counties of Essex and Kent. Flue-cured tobacco is occasionally infected by etch. The virus overwinters in ground cherry, of which there are two common species occurring as weeds in fencerows, waste areas, and along roadsides. In June or early July, aphids transmit the virus from ground cherry to tobacco, pepper and tomato crops.

Control

Since late-planted tobacco is severely stunted by the virus, early planting is recommended. Also, tobacco should not be planted alongside weedy fencerows or near other waste areas. The variety Harwin is moderately resistant to etch. Good aphid control should reduce the severity of the disease.

(c) **Other Viruses** - A number of other virus diseases may affect tobacco and cause severe damage. Symptoms may include severe leaf spotting, leaf mottling and death of leaf tissue. These viruses are transmitted by aphids.

Control

Tobacco fields should be checked every few days, particularly from late June until the first of August, for the presence of aphids. Apply one of the recommended insecticides (see page 11) at the first appearance of these insects.

POLE ROT

(a) **Flue-cured Tobacco** - Pole rot caused by certain bacteria or fungi frequently develops during the yellowing stage of the flue-curing process.

Control

Curing trouble of this kind is most likely to occur when yellowing is prolonged or when excessively large tobacco or wet tobacco is crowded into the kiln. This reduces air circulation, and increases humidity.

In addition, when the outside air is hot and humid, it is more difficult to reduce humidity in the kiln.

When these conditions prevail, reducing the kiln load and ventilating earlier in the cure will help prevent the development of rot.

(b) **Burley Tobacco** - Wet weather during curing often causes darkening or spoilage of burley leaf. This injury, commonly called barn burn, is caused by fungi and bacteria growing on the cured leaves when they become too moist. Burley tobacco cures best at 65 to 70% relative humidity. Barn burn may develop rapidly if the relative humidity in the barn exceeds 85 to 90% for more than 24 hours.

Control

To avoid excessive moisture in the barn, open the ventilators during the day when the weather is dry, and close them at night to keep out dampness. When wet weather threatens, close the barn.

Special heating equipment, which maintains the proper humidity for curing and prevents barn burn, is available.

SUCKER CONTROL

The following products may be applied before or after topping. Generally an application during the early to late bud stage is the most satisfactory.

All of the products listed may be used on flue-cured tobacco. For burley tobacco, use only those products that include this tobacco type on the label.

Normally one application is sufficient. However, conditions such as an uneven crop or poor timing may reduce the effectiveness of the first application and in this case a second application 5 to 7 days after the first may be beneficial.

NOTE: Directions for use vary somewhat from one product to another; therefore it is extremely important to read the label carefully and follow all precautions and directions. Conditions such as improper mixing, poor timing, boom pressures above 138 kPa (20 p.s.i.) and spraying during windy or excessively hot weather can result in crop damage. A lower rate of sucker control may be required on very tender tobacco.

TABLE 4. LITRES OF SPRAY MIXTURE PER HECTARE

	Litres of Product		Litres of Water
	Before Topping	After Topping	
Antak	17	20	450
Chiptac	17	19	450
Contak	17	20	450
Delete	17	20	450
Emtrol	20	22	450
Emtrol Ten	17	20	450
Fair-Tac	17	17	465
Pfizer 10	17	20	450
Royaltac	17	19	450

WEED CONTROL

Ontario Ministry of Agriculture and Food Publication 75, *1984 Guide to Chemical Weed Control* contains complete information on weed control and should be referred to where more detail is required.

TOBACCO

(a) *Germinating annual weeds*

Apply Enide 50W at 9 to 13.0 kg/ha of soil sprayed (approximately 2.25 to 3.25 kg per planted ha). Apply in a 25 cm band over the row in 150 to 300 L of water immediately after transplanting. Prolonged dry conditions after planting may reduce the effectiveness of Enide. Registered only for flue-cured tobacco.

(b) *Germinating weeds and horsetail*

Use Tillam (720 g/L) at 6.3 to 7.7 L/ha as a preplant incorporated treatment applied in 150 to 300 L of water.

Enide may persist in the soil and injure the fall cereal crop. To reduce chance of injury, it is important that Enide be applied in a 25 cm band and that the soil be worked at right angles to the tobacco rows after harvest. Rate may be varied within the indicated range with lower rates on very coarse (light) tobacco soils.

Tillam should be applied to a dry soil surface before transplanting and incorporated within 10 minutes with a double disk or springtooth cultivator. A second incorporation at right angles in tandem with a harrow should be done as soon as possible. Use 6.3 L on light sands and 7.7 L on loamy sands. Delay transplanting four days after application. Tillam can also be applied at the higher rate prior to row fumigation.

RYE AND WHEAT

For more complete information on weed control in these crops refer to OMAF Publication 75, *1984 Guide to Chemical Weed Control*.

Legume plants such as vetch and clover can be especially troublesome if allowed to grow in rye or wheat fields since they add nitrogen to the soil. These and other broadleaf weeds may be controlled with 2,4-D.

Apply 350 to 550 g acid equivalent in 150 to 200 L of water/ha. **Use only the amine form.** For example, a 500 g/L amine formulation would be applied at the rate of 700 mL to 1.10 L/ha.

The treatment should be applied during early May, one year before tobacco. Spray before the winter grain is taller than 30 cm (top leaf extended) to ensure contact of the weeds with the chemical and reduce crop damage.

Equipment that has been used to spray 2,4-D; 2,4,5-T; MCPA or related herbicides should not be used to spray pesticides or other materials on susceptible crops such as tobacco, beans, peppers, cucumbers, tomatoes, squash, cabbage, cauliflower, pumpkins, melons and turnips. These herbicides should not be used near susceptible crops because of the danger of damage from spray drift.

Vapors from 2,4-D and related materials can injure susceptible crops.
To reduce the hazard of drift:

1. Use only the amine formulation.
2. Use coarse nozzles and low pressure.
3. Spray only on calm days.
4. Do not fill or clean the sprayer near the greenhouse or the water supply.

FERTILIZATION AND SOIL MANAGEMENT

Proper fertilization plays an essential part in maintaining maximum yields of high quality tobacco. The analyses of fertilizer and rates of application vary with the type of tobacco and the soil upon which it is grown. Effective use of fertilizers is related to soil fertility and management, soil organic matter, manure application, soil reaction, cultural methods, incidence of disease, and variety of tobacco. Commercial fertilizers supplement and balance the plant food in the soil. Suitable crop rotations and cover crops supply organic matter that reduces leaching of plant nutrients and lessens soil erosion.

The Fertilizers Act

This is an Act for the regulation and control of Agricultural Fertilizers which is administered by the Plant Products Division of Agriculture Canada.

According to regulations under the Fertilizers Act, each fertilizer to which minor elements have been intentionally added must have a label guarantee showing the amount of each minor element expressed in percent on an elemental basis.

Standards for Tobacco Fertilizers

There are special standards recommended for the forms of nitrogen and the amounts of magnesium and chlorine that should be present in tobacco fertilizers.

NITROGEN - At least one-quarter of the total nitrogen should be in the nitrate form except for side-dressing fertilizer, in which at least one-half of the nitrogen should be in the nitrate form.

CHLORINE - The level of chlorine must be controlled within narrow limits because of its effect on seedling growth and burn and moisture holding capacity of the cured leaf. A high level of chlorine in the cured leaf lowers the burning quality and causes excess moisture uptake by the leaf. Excess chlorine in the seedbed may be toxic to young seedlings and may also contribute to damage from soluble salts.

Seedbed - It is recommended that the special tobacco seedbed fertilizer, 4-30-8, contain no more than 1.25% chlorine.

Flue-cured - The amount of chlorine is regulated as follows: (a) a fertilizer containing less than 2% nitrogen should have a maximum chlorine content of 3% and a minimum of 0; or (b) a fertilizer containing 2% or more nitrogen shall have a minimum chlorine content equal to the guaranteed nitrogen content and the maximum chlorine content shall not exceed the minimum by more than one percent. For example, a 3-9-18 analysis should contain a minimum of 3% and a maximum of 4% chlorine.

Burley - No more than 1.25% chlorine is allowed in the fertilizer.

MAGNESIUM

Seedbed - The special tobacco seedbed fertilizer, 4-30-8, should contain a minimum of 2% water soluble magnesium.

Flue-cured - Flue-cured tobacco fertilizers, except for the seedbed fertilizer, should contain a level of water soluble magnesium that is equivalent to 40% of the guaranteed nitrogen content of the fertilizer. For example, a 3-9-18 analysis should contain 1.2% water soluble magnesium.

Burley - Burley tobacco fertilizers should contain 0.6% water soluble magnesium (Mg).

Fertilizer Analyses

The following analyses are recommended by the Ontario Soil Management Research Committee.

TABLE 5.

FLUE-CURED

Planting and Early Side-dressing Fertilizers

3-6-18
3-9-18 or 4-12-24
3-12-18
2-10-16 or 3-15-24
5-10-30

Late Side-dressing Fertilizers

3-6-18
9-0-27

Seedbed Fertilizer

4-30-8

BURLEY

Field Fertilizers

3-18-18
5-10-15 or 7-14-21

Seedbed Fertilizer

4-30-8

Seedbed Fertilization

The following general recommendations are for all types of tobacco grown on muck in conventional seedbeds.

Information on fertilizing seedlings produced by other methods may be obtained at the Agriculture Canada Research Station, Delhi and in Ontario Ministry of Agriculture & Food Factsheet *Culture of Tobacco Seedlings in Todd Cells*, Agdex No. 181.

NOTE: Avoid the use of growth media containing composted sewage sludge.

Soil Testing - Nutrient levels, pH and total salts in the seedbed can be determined by having samples of the seedbed soil tested at the Department of Horticultural Science, Ontario Agricultural College, University of Guelph, Guelph, Ontario N1G 2W1. To determine whether any variation from the general fertilizer recommendation before seeding is required, samples should be taken in the fall after any new muck has been incorporated. Samples may also be taken in April for guidance regarding fertilization during May.

Fertilization Before Seeding - Apply 25 kg of 4-30-8 special tobacco seedbed fertilizer/100 m² of seedbed area.

Fertilizer may be applied before or after steaming. Spread the fertilizer uniformly and thoroughly mix with the top 4 cm of seedbed.

CAUTION: High rates, shallow incorporation and uneven distribution of fertilizer may cause a problem with soluble salts resulting in thin stands and patchy growth.

Fertilization During May - At least two weeks before planting, apply liquid, soluble powder or granular fertilizer at a rate that will supply 0.25 kg of nitrogen (N) per 100 m² of seedbed area. For example, a soluble complete fertilizer containing 15% nitrogen would be applied at the rate of 1.7 kg dissolved in at least 200 L of water/100 m². Wash the solution off the plants immediately after application, otherwise burning may occur.

If plant growth is slow and leaves are pale green this treatment may be repeated.

NOTE:

1. **Nitrogen deficiency** often occurs, during early May, in seedbeds that were chemically sterilized. The feeding program recommended under "Fertilization During May" should begin in the first week of May in these seedbeds.

2. **Potash deficiency** occasionally develops in seedbeds composed of a high proportion of new muck and fertilized with the normal rate of 4-30-8. A whitish-yellow mottling of the interveinal tissue of the older leaves is a sign of potash deficiency. Although the lack of potash is seldom severe enough to affect growth it is adviseable, in this situation, to fertilize during May with a complete fertilizer rather than one that supplies only nitrogen.

Soluble Salts

High levels of soluble salts often accumulate in the seedbed, causing reduced and/or delayed germination, tipping-over, stunting and root damage. Fertilizer is generally the main source of salts although in some areas the water from deep wells may be very high in salts.

(a) Preventing Salt Problems

Do not apply more than the recommended amount of fertilizer before seeding.

Leaching of the seedbed during the fall and before spreading new muck, is recommended as a means of avoiding salt problems. For effective and uniform leaching the following procedure is suggested.

Step 1 Thoroughly moisten the seedbed with a sprinkler, to the depth of soil moisture or at least 30 cm. This is easily done in June but, later in the summer or fall, several days may be required to have the seedbed uniformly moistened.

Step 2 Apply at least 10,000 L of water/100 m² of seedbed area. This may be done by flooding or with a sprinkler.

Step 3 After 3 or 4 days repeat step number 2.

NOTE: Thorough moistening before flooding is essential. Flooding a dry seedbed results in uneven water penetration which accomplishes salt removal in some areas but not in others.

(b) Correcting Salt Problems

During the greenhouse season salt problems usually occur in areas of the seedbed that dry most rapidly (loose areas or areas receiving less water).

This problem can be corrected by leaching. In fact, if the problem is detected early enough, corrective measures can produce a normal stand of plants. Samples of muck, from the seedbed, may be tested at the Research Station to determine the level of soluble salts.

To obtain effective leaching, first moisten the seedbed and then apply at least 2,500 L of water/100 m² of seedbed area. If, after testing a sample, the salts are still high, repeat the leaching procedure.

Field Fertilization

Fertilizer requirements for tobacco should be determined by using a soil test along with information on soil type, past management and yield and quality of tobacco usually produced on the field.

Nitrogen, phosphate and potash are the main nutrients to be considered in a fertilizer program. To provide dependable recommendations fields should be tested before each tobacco crop.

Phosphate and Potash - Phosphate and potash requirements for flue-cured and burley tobaccos are presented in the following table. This table should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used in the OMAF laboratory. After deciding on the amount of nitrogen you wish to apply choose an analysis of fertilizer that most closely fits the phosphate and potash requirements as indicated by your soil test.

NOTE: Where there is a requirement of more than 180 kg of phosphate and 220 kg of potash it is considered best to apply the additional amounts as a separate application rather than in bands at planting time.

TABLE 6. PHOSPHATE AND POTASH REQUIREMENTS FOR TOBACCO BASED ON OMAF SOIL TESTS

Phosphorus Soil Test (PPM)	Rating	Phosphate (P_2O_5) Required-kg/ha	Potassium Soil Test (PPM)	Rating	Potash (K_2O) Required-kg/ha
0 - 3	Low	260	0 - 15	Low	270
4 - 5		250	15 - 30		260
6 - 7		240	31 - 45		240
8 - 9		230	46 - 60		220
10 - 12		220	61 - 80		190
13 - 15		210	81 - 100		170
16 - 20	Medium	200	101 - 120	Medium	150
21 - 25		180	121 - 150		140
26 - 30		160	151 - 180		130
31 - 40		140	181 - 210		120
41 - 50		110	211 - 250		110
51 - 60		80	250+	Very High	100
61 - 80	High	50			
80+	Very High	20			

Flue-Cured Tobacco Fertilization

Nitrogen - Under Ontario conditions there is no reliable test for nitrogen. In addition the amount of nitrogen available from organic matter will vary from season to season depending largely on rainfall and temperature. For these reasons it is extremely difficult to determine the optimum amount to apply.

Usually previous tobacco crops provide the most reliable basis for determining the nitrogen requirement. A record of each field should be kept over the years to have an accurate picture of maturity, size, quality and yield for more than one tobacco crop year. The amount of nitrogen applied to previous tobacco crops may be used as a base from which to determine nitrogen requirements within a certain range.

A range of 16 to 36 kg/ha of nitrogen will cover practically all situations from sandy loam to sandy soils. Using the rate applied to previous crops as a base you can make adjustments within the indicated range depending on your judgement of the nitrogen-supplying power of the soil. It is generally considered that an adjustment of at least 4 kg/ha of nitrogen would be required to make any significant change in the crop. Also adjustments in the direct fertilizer application of nitrogen may help but cannot be expected to completely correct a problem of too much or too little nitrogen in the soil. The use of nitrogen on the previous rye or wheat crop and the application of manure are just as important as the amount of nitrogen directly applied to the crop.

TABLE 7. ANALYSES AVAILABLE THROUGH THE SOIL TESTING AND PLANT ANALYSIS LABORATORY, DEPARTMENT OF LAND RESOURCE SCIENCE, UNIVERSITY OF GUELPH

Material	Analyses	Availability	Cost/Sample
1. Farm soils	plant available phosphorus, potassium and magnesium + pH (calcium and salt concentration* if required)	all times	no charge - cost borne by Ontario Ministry of Agriculture and Food
2. Home garden and lawn soils	as above	all times	\$1.00
3. Soil	available manganese and zinc	all times	\$3.00
4. Soil	organic matter	all times	\$5.00
5. Soil	texture (% sand, silt and clay)	enquire at lab	quoted on request
6. Soil	other analyses may be available for groups of over 20 samples	enquire at lab	quoted on request
7. Liming materials	calcium and magnesium content, neutralizing value, particle size	all times	\$15.00
8. Dried plant and other organic materials**	nitrogen, phosphorus, potassium, calcium, and magnesium	all times	\$14.00
9. Dried plant and other organic materials**	boron, copper, manganese and zinc	all times	\$14.00
10. Dried plant and other organic materials**	9 elements listed in 7 and 8	all times	\$18.00
11. Manure and other moist organic matter	nitrogen, phosphorus, potassium, calcium, and magnesium and % DM	all times	\$17.00
12. Organic materials	various elements	enquire at lab	quoted on request

* Electrical conductivity.

** Analysis of feed samples is arranged through the Department of Animal & Poultry Science.

TABLE 8. GENERAL NITROGEN RECOMMENDATIONS

	kg/ha Nitrogen	Examples kg/ha
Sand	30 - 36	1000 to 1200 kg of a 3% nitrogen fertilizer such as 3-9-18 or 750 to 900 kg of a 4% nitrogen fertilizer such as 4-12-24 or 600 to 720 kg of a 5% nitrogen fertilizer such as 5-10-30
Loamy Sand	24 - 27	800 to 900 kg of a 3% nitrogen fertilizer such as 3-12-18 or 3-9-18
Sandy Loam	16 - 20	800 to 1000 kg of a 2% nitrogen fertilizer such as 2-10-16

Magnesium - Magnesium is usually supplied in sufficient quantities in the complete fertilizer to prevent magnesium deficiency commonly called "sand down".

A soil test is needed to identify the few cases where extra magnesium is required. When the soil test value for magnesium falls below 30, a side-dress application of 150 - 200 kg/ha of Sul-Po-Mag or K-Mag is recommended. This extra application is also recommended with magnesium soil test values of 30 to 40 when the ratio of calcium to magnesium is 40 or more. For example, soil test values of 1500 for calcium and 36 for magnesium (ratio of 42) indicate the need for extra magnesium.

Side-dressing - Excess rainfall, during the first 4 to 5 weeks after planting, may cause considerable leaching of certain nutrients, particularly nitrogen, and to a lesser extent, potash, magnesium and chlorine. Rainfall of 25 mm or more during a 24-hour period is sufficient to cause leaching when the soil is moist prior to the rain.

Side-dressing, to replace nutrients lost through leaching, should be done soon after (within 4 to 5 days) the leaching has occurred. A low phosphate tobacco fertilizer of the type used at planting is preferred for any application up to late June (about June 25). The special side-dressing fertilizers are suited mainly to application during the last few days in June and in early July.

The required amount of side-dressing will vary according to several factors including amount of rainfall, amount of fertilizer applied at planting, soil texture, drainage and fertility. As a general guide the following amounts of nitrogen are suggested when side-dressing is required:

TABLE 9. GENERAL SIDE-DRESSING RECOMMENDATIONS

	kg/ha Nitrogen	Examples kg/ha
Sand	9 to 11	3-6-18 at 300 to 375 kg or 9-0-27 at 100 to 125 kg
Loamy Sand	7 to 9	3-6-18 at 225 to 300 kg or 9-0-27 at 80 to 100 kg
Sandy Loam	5 to 7	3-6-18 at 165 to 225 kg or 9-0-27 at 55 to 80 kg

Burley Tobacco Fertilization

Sandy loam and gravelly loam soils produce the best quality burley. Clay loam soils tend to produce tobacco too high in chlorine and too low in potassium content, two factors that contribute to poor burning quality. The production of burley with good burning quality is of utmost importance if the domestic and export markets are to be maintained and expanded.

Nitrogen - Under Ontario conditions there is no reliable test for nitrogen. The decision on the amount of nitrogen required should be based on past fertilization, cropping history and the performance of previous burley crops.

The following table serves as a guide for inexperienced growers or growers who may want to change their fertilization management in order to adapt to the heavier and darker quality burley that is now required by the industry.

TABLE 10.

	kg/ha Nitrogen
1. Sands to Loamy Sands	220
2. Sandy or Gravelly Loams	200
3. Sandy Loams to Loams	170

NOTE: Fertilizer formulations containing muriate of potash (potassium chloride) should not be used on burley tobacco because of the high chlorine level which lowers the burning quality of the leaf.

Manure

Manure can be used as a source of plant food and organic matter. The content of N, P_2O_5 and K_2O in manure is extremely variable. Chemical analysis will indicate more accurately, than the following table, the amounts of nutrients available for crop production from the particular manure you intend to use, provided a representative sample can be obtained. A manure analysis service is offered through the Department of Land Resource Science, University of Guelph. Cost of this service is shown in the table on page 25. Manure testing kits are available at County Agricultural Offices. Figures in the table are an average and should be considered only as a rough guide.

TABLE 11. AVERAGE PLANT FOOD AVAILABLE FROM MANURE IN FIRST CROP YEAR

Source	Tonnes/ha	N	kg/ha P_2O_5	K_2O
Cattle	12	36	12	53
Swine	12	46	24	31
Poultry	5	88	38	48

FLUE-CURED TOBACCO

Manure is not required on many farms where nitrogen is used during the spring and summer on the rye or wheat crop. However, sandy tobacco soils, particularly sandy knolls, usually benefit from an application of 12 to 18 tonnes/ha of cattle or swine manure. As the table indicates, poultry manure is high in nitrogen and is generally not recommended.

The use of manure on soils high in fertility is likely to delay maturity and to lower quality.

BURLEY TOBACCO

If manure is to be used, it should be applied at least a year before the burley crop. This allows for adequate decomposition of the organic matter and the disappearance of chlorine. Manure applied too close to tobacco delays maturity, increases the chlorine content, and lowers burning quality of the leaf.

Rotations

FLUE-CURED TOBACCO

In a two-year rotation with tobacco, rye has generally proven to be better than wheat in maintaining or increasing the amount of organic matter in the soil. Wheat is more subject to winter kill and factors such as fall seeding date, nutrient shortage and pH are much more critical with wheat as compared to rye. For example, wheat can be seriously affected in certain fields by a shortage of manganese while in the same fields tobacco and rye grow normally. Wheat may be substituted for rye where fertility is high, especially on soils with a sandy loam to loam texture. Wheat is unlikely to produce sufficient crop residue on medium to course-textured tobacco soils.

TABLE 12. FERTILIZATION OF RYE

	Nitrogen (kg/ha)	Examples (kg/ha)
(a) Early spring when growth starts		
1. Sand	45	Ammonium nitrate (33-34% N) at 135 kg or Urea (45-46% N) at 100 kg.
2. Loamy Sand	35	Ammonium nitrate at 105 kg or Urea at 80 kg.
3. Sandy Loam	25	Ammonium nitrate at 75 kg or Urea at 55 kg.

NOTE: Nitrogen should not be used in the spring in fields where tobacco is oversized and matures late or in loamy sand to sandy loam soils where the field has been out of tobacco for more than one year.

(b) Summer - To crop residues	25-30	Ammonium nitrate at 75-90 kg/ha or Urea at 60-65 kg/ha.
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NOTE:

1. Less than 25 kg of N should be applied in the summer to sandy loam soils where slow maturity has been experienced in the tobacco crop.
2. Maturity of tobacco may be delayed if nitrogen is applied after mid-August or at a high rate.

Fertilization of Wheat

Wheat should generally be fertilized in the spring with double the nitrogen rates recommended for rye in the previous table. Rates should be reduced by one-half in fields where tobacco is oversized and matures late or in medium to heavy soils where the field has been out of tobacco for more than one year.

For crop residues apply the same rate of nitrogen as indicated for rye and according to the precautions in notes 1. and 2.

BURLEY TOBACCO

Burley should not follow crops where high rates of muriate of potash have been used because of the danger of increasing the chlorine level and lowering the burning quality of the leaf.

Burley is usually grown in rotation with other crops. Crop rotation is important to minimize virus diseases, to reduce the buildup of black root rot disease, and to maintain good soil structure and composition.

The crop grown before burley is important in the rotation. Winter wheat and a winter cover crop of fall rye are two of the best. Tomato and tobacco are very closely associated and have similar diseases. They should not follow one another closely in a rotation. There is a risk with a legume crop such as alfalfa or clover, before burley, unless plowed in the fall. Spring plowing of leguminous crops usually results in later maturity and a darker or lower quality leaf.

Continuous cropping of burley tobacco on the same soil can improve leaf quality but black root rot disease is more common under conditions of continuous culture, particularly under cool, wet conditions in the spring. Stands may become spotty or drastically reduced. Soil structure can also be impaired under a burley monoculture unless a winter cover crop of fall rye is incorporated into the sequence.

Soil Testing (Field)

Fall is the best time to take soil samples for tobacco. Soil sample boxes and questionnaire forms may be obtained from your nearest Research Station, College of Agricultural Technology, Agricultural office, or from the Department of Land Resource Science, University of Guelph. Proper sampling procedure is outlined on the questionnaire.

Tissue Testing

A service for the chemical analysis of plants and other organic materials such as sludge and manure is available at the Department of Land Resource Science, University of Guelph. This service is available on a charge per sample basis. For more information inquire at your local Agricultural office or Research Station.

Micronutrients

Additions of the micronutrients boron, copper, iron, manganese, molybdenum and zinc are generally not required for tobacco in Ontario. Surveys of tobacco soil and leaf tissue show that levels are usually adequate and, in some cases, excessive. For example, very high levels of iron, manganese and zinc are occasionally found in the cured leaf and these are associated with a certain type of "grey" tobacco.

Before applying any micronutrient it is important to establish the need since the range between beneficial and harmful amounts is very narrow. A tissue test for boron, copper, manganese and zinc is available on a charge per sample basis through the Soil Testing and Plant Analysis Laboratory, Department of Land Resource Science, University of Guelph. The same laboratory offers a soil test for manganese and zinc, also on a charge per sample basis (see page 25).

Liming

The need for limestone is determined by testing the soil to find the reaction (pH). On tobacco soils the most reliable indication of pH is obtained from late fall or early spring sampling. The soil pH for tobacco should be above 5.5. Wheat, which is often grown in rotation with tobacco, is favored by a pH of 6.0 or slightly above.

Limestone is recommended when the soil pH is below 5.6. Dolomitic limestone should be used because most tobacco soils have magnesium values of less than 100 on the basis of OMAF soil tests.

The rate of limestone specified on the OMAF soil test report is the amount required to raise the pH to 6.0. Excessive use of limestone to raise the pH beyond 6.5 may decrease the availability of certain micronutrients and create favorable conditions for the development of black root rot.

For further information on pH, liming and limestone quality refer to OMAF Factsheet *Soil Acidity and Liming* Agdex No. 534.

NOTE: Plowing limestone directly into the soil, without prior working in, is likely to reduce the effectiveness of limestone in raising pH.

Fertilizer Placement

Fertilizer used at transplanting should be applied in bands 10 cm on each side of the row, and level with or slightly below the root crown (8 to 10 cm deep).

CAUTION: Closer placement of fertilizer could result in root injury, and wider placement could delay early growth.

Broadcasting a complete tobacco fertilizer is a wasteful practice, and may be detrimental to yield and quality under high rainfall or excessive irrigation.

Starter or Transplanting Fertilizers

Starter fertilizers are not recommended. These fertilizers in combination with certain insecticides in the planting water may injure newly transplanted plants, causing either death or stunting (see page 10 under **Seed Maggots**).

Foliage Feeding

Although the tobacco plant can absorb certain nutrients through the leaves in small amounts, spraying fertilizer on the leaves is an impractical method of correcting nitrogen, phosphorus, or potassium deficiency. If additional amounts of these nutrients are required after transplanting, a side-dress application is recommended.

Calibration of Tobacco Fertilizer Applicators

A fertilizer applicator should be calibrated periodically to ensure desired rates of fertilizer application. The amount of fertilizer per plant depends on the plant spacing and rate of application as shown in the following table. For example, when applying 1000 kg/ha of fertilizer and using a plant spacing of 61 x 107 cm (24 x 42 inches), 25 kg will fertilize 383 plants.

When calibrating an applicator, first place and level approximately 15 kg of fertilizer in the hopper, mark this level, and then put in 25 kg of fertilizer. Plant the desired number of plants, as shown on the table, and check the level in the hopper. If the fertilizer is above the mark, too little is being applied, and if below the mark, too much is being applied. Do not place the fertilizer in the hopper until immediately before transplanting, to avoid packing, as this will result in poor calibration. This method will give a fairly accurate calibration of the rate of application, but it is also advisable to check the fertilizer on an acre and field basis.

TABLE 13

[illegible]

VARIETIES

FLUE-CURED TOBACCO

Varieties of flue-cured tobacco recommended for use in Ontario are: Delgold, Delhi 76, Newdel, Nordel, Virginia 115 and Candel. In recent years, breeding for increased alkaloid content has been emphasized. The newer recommended varieties Delgold, Newdel, Nordel and Candel reflect improvements in this area.

The following variety descriptions are from comparisons made at the Research Station, Delhi, where all have received the same treatment.

DELGOLD was developed at the Research Station, Delhi, from crosses involving *Nicotiana rustica*, Hicks Broadleaf, and Virginia 115. The plant is light green in color and is fast growing in the greenhouse and in the field. It has intermediate to high tolerance to black root rot and to weather fleck. Delgold is tall and is cylindrical in shape. The leaf has good width, is longer than Virginia 115 but is narrower in the butt section. Ground sucker growth is quite low. Toughness of the leaf at harvest time compares favorably with Virginia 115. The variety is high yielding and cures easily. In the cured leaf, shades of light orange will predominate throughout the mid-stalk leaves while the upper leaves will range from a light orange to orange color.

DELHI 76 was developed at the Research Station, Delhi from treatment of Delhi 34 seed with Gamma rays to induce mutations. The plant is medium green in color and fast growing in the greenhouse and in the field. It is tall with leaves equally spaced up the stalk. Ground sucker growth may be a problem on some farms. Delhi 76 has a high tolerance to black root rot and to weather fleck. The yield is high and the leaf cures satisfactorily to an orange color particularly in the upper leaves. The leaf cures easily and has good texture and graininess.

NEWDEL was developed at the Research Station, Delhi from crosses involving *Nicotiana rustica*, Delhi 34 and Virginia 115. The plant is light green in color, medium tall and tapers slightly toward the top. It is fast growing in the greenhouse and in the field. The leaf has good width and length. Newdel has intermediate tolerance to black root rot and is intermediate to high in tolerance to weather fleck. The variety is intermediate to high in yield and cures easily to a uniform color. In the cured leaf, shades of rich light orange color will predominate.

NORDEL was developed at the Research Station, Delhi from crosses involving *Nicotiana rustica*, Delhi 34 and Virginia 115. Nordel is light green in color and is fast growing in the greenhouse and in the field. It has intermediate to high tolerance to black root rot and intermediate tolerance to weather fleck. The plant style is somewhat similar to Virginia 115 but the plant is a little taller and the top elongates more like Delhi 76. Ground sucker growth has not been a problem but may be more than that of Virginia 115. The yield is intermediate and the cured leaf tends to be a light orange to orange color.

VIRGINIA 115 was developed in the U.S.A. from a cross between Hicks Broadleaf and Coker 139. Virginia 115 is a short-stalked plant with closely spaced leaves. Early seedling growth may be slow, with heart leaves yellowish and slightly deformed. However, the variety will outgrow these characteristics and produce vigorous seedlings by transplanting time. Virginia 115 is intermediate in tolerance to black root rot and intermediate to high in tolerance to weather fleck. The tip leaves require adequate moisture to fill out properly and the lower leaves may be affected by leaf drop. The sand leaves are often primed before topping. The tip leaves are slightly narrow and distinctly crinkled. Virginia 115 is intermediate to high in yield. The cured leaf tends to have good texture and graininess, but is less uniform in color than Delhi 76. Muddy-faced leaves may appear in the mid-stalk and upper stalk primings.

CANDEL was developed at the Research Station, Delhi from crosses involving *Nicotiana rustica*, Delhi 34, Hicks Broadleaf and Virginia 115. The plant is dark green in color and fast growing. It has a short stalk and is cylindrical in shape. Candel is intermediate in tolerance to black root rot and weather fleck. Ground sucker growth is quite low. The variety is early flowering and is early maturing. Soon after topping the leaves become crinkled and as the cultivar progresses towards maturity a uniform yellow to yellow-green pebbled color appears on the upper leaves. All leaves have wide shoulders and tip leaves have good length and width. Candel is intermediate to high in yield and cures easily to a uniform color. In the cured leaf shades of rich orange will predominate.

TABLE 14. FLUE-CURED VARIETY PERFORMANCE (3-Year Average 1981-1983)

Variety	Yield kg/ha	Grade \$/kg	Number of Leaves	Days to Topping	Topping Height cm	Ground Suckers kg/ha
Delhi 76	3031	3.57	17.3	60.9	96.7	60.6
Delgold	3117	3.51	18.9	61.4	90.7	14.9
Newdel	2828	3.48	18.7	59.4	87.1	21.5
Virginia 115	2906	3.43	18.3	60.4	84.0	18.7
Candel	2961	3.55	18.2	59.4	84.2	12.2
Nordel	2613	3.50	17.3	56.3	82.8	24.4

Variety	Black Root ² Rot Rating	Weather ³ Fleck	Company ⁴ Rating	Total Alkaloids %	Reducing Sugars %
Delhi 76	122	1.4	75	2.3	24.3
Delgold	104	1.9	73	2.7	22.7
Newdel	93	2.1	69	2.7	22.8
Virginia 115	100	1.7	70	2.3	22.8
Candel	96	1.7	83	2.5	22.9
Nordel	115	2.4	72	3.0	21.1

- 1 Two-year average based on 1981 and 1982 only
 2 Higher number more tolerance
 3 Lower number more tolerance
 4 Average of 4 companies, higher number preferred

TABLE 15. SUMMARY OF GRADES EXPRESSED AS PERCENT (3-Year Average 1981-1983)

Variety	Sands %	CL %	CF %	BL %	BF %	ND %	CR %	BK %
Delhi 76	10.6	27.2	7.9	14.9	36.4	0.9	1.3	0.0
Delgold	10.3	23.7	8.7	18.7	34.1	1.4	3.0	0.1
Newdel	10.8	21.2	11.3	18.3	32.1	1.3	4.7	0.0
Virginia 115	11.9	24.0	9.9	7.4	41.4	1.2	4.5	0.3
Candel	11.7	19.7	14.2	9.7	43.7	1.0	0.9	0.0
Nordel	11.3	23.4	15.8	6.0	42.0	0.3	1.4	0.0

- 1 2-year average based on 1981 & 1982 only.

BURLEY TOBACCO

KENTUCKY 21 X 10 - The F1 hybrid is a high yielding variety with high grade quality. Quality of the lower leaves is maintained over a longer period of time so that it can be harvested later than Burley 1 or Harwin. Optimum harvest maturity is approximately 4 weeks after topping. Topping height and leaf number is lower but tip leaves are larger as compared to Burley 1 and Harwin. This variety has slightly lower tolerance to weather fleck and black root rot than Burley 1 and Harwin. In addition this variety is highly resistant to tobacco mosaic virus and wildfire and moderately tolerant to tobacco etch virus.

HARWIN - Yield and grade quality slightly lower than Kentucky 21 x 10. Plants mature about the same time as Kentucky 21 x 10. Topping height is slightly higher and tip leaf area lower than for Kentucky 21 x 10. Lower leaves are larger and tend to maintain their quality longer in the field than Burley 1. Tip leaves are narrow and longer than Burley 1. Moderately resistant to black and brown root rots and weather fleck. Moderately tolerant to tobacco etch virus, but susceptible to tobacco mosaic virus.

BURLEY 1 - Lower yield with lighter cured leaves than other varieties. Moderately resistant to black and brown root rots and weather fleck, but susceptible to tobacco mosaic virus and tobacco etch virus. Topping height is higher with closer spacing of leaves on the stalk than other varieties. Tip leaves are not as large as other varieties. Lower leaves tend to mature early with a tendency to dry before harvest.

TABLE 16. BURLEY VARIETY PERFORMANCE (5-Year Average 1977-1981)

	KENTUCKY 21 X 10	HARWIN	BURLEY ¹
Yield (kg/ha)	3213	2988	2830
Grade Index (¢/kg)	169.1	167.8	166.7
Number of Leaves	19.3	21.5	22.0
Days to Flower	59	59	57
Topping Height (cm)	92.8	93.2	97.8
Average Area of 3 Tip Leaves ¹ (cm ²)	1384	1259	1099
Company Ratings ²	78	71	61
Total Alkaloids ³ (%)	4.72	4.19	4.66
Black Root Rot Rating ⁴	1.7	n.a.	1.0
Weather Fleck Rating ⁵	4.72	4.28	3.71

¹ Results from 1980-82.

² Results are average of 6 companies with higher number more desirable and based on 1980 and 81 ratings.

³ Results averaged over 1977-79.

⁴ Higher number means more growth in disease inoculated plots.

⁵ Number indicates percentage leaf area damaged by weather fleck during 1980 and 81.

CULTURAL PRACTICES

Plant Population and Spacing

FLUE-CURED TOBACCO

The most desirable plant population will vary somewhat from farm to farm depending mainly on soil fertility. A suitable population for most farms is within a range of 15321 to 17634 plants/ha (6200 to 7100 plants per acre). Slightly higher yields may be obtained with higher populations but this advantage may be offset by the added costs of handling more leaves. Also as plant population is increased, there is a tendency to produce a thinner leaf which may be more susceptible to weather fleck.

As row width is increased up to 122 cm (48 inches) yield tends to decrease.

Recommended plant spacings for flue-cured tobacco are indicated in the shaded area of the following table:

TABLE 17. PLANT SPACING WITHIN THE ROW

Row Width	*41 **16	46 18	51 20	53 21	56 22	58 23	61 24	66 26
*102 ***40	***23,912 ****9,801	21,313 8,712	19,223 7,840	18,498 7,468	177,507 7,128	16,903 6,818	16,072 6,534	14,854 6,032
107 42	22,795 9,334	20,317 8,297	18,325 7,467	17,634 7,112	16,689 6,789	16,113 6,493	15,321 6,223	14,160 5,744
112 44	21,777 8,910	19,410 7,920	17,507 7,128	16,846 6,788	15,944 6,480	15,394 6,154	14,637 5,940	13,528 5,483
117 46	20,846 8,523	18,580 7,576	16,759 6,818	16,126 6,494	15,263 6,198	14,736 5,929	14,011 5,682	12,950 5,244
122 48	19,992 8,168	17,819 7,260	16,072 6,534	15,466 6,229	14,637 5,940	14,132 5,682	13,437 5,445	12,419 5,026

* Centimetres

** Inches

*** Plants per hectare

**** Plants per acre

BURLEY TOBACCO

Burley tobacco is usually transplanted 41 cm apart in the row and 102 cm apart between rows (about 16 x 40 inches) giving a plant population of 23,912 plants per ha (about 9,800 plants per acre). This plant spacing promotes quality and yield of tobacco without seriously hampering topping, suckering, and harvesting operations.

Irrigation

For more information on irrigation refer to the following Ontario Ministry of Agriculture and Food Factsheets: *Tobacco Irrigation With Gun Sprinklers* Agdex No. 181/565, March, 1980 and *Tobacco Irrigation With Travelling Gun Sprinklers* Agdex No. 181/565, November, 1981.

A permit is required for the taking of more than 45,000 L of water in a day from any ground or surface source of water supply, or a combination thereof for the purpose of irrigating. For further information contact your nearest office of Ontario Ministry of the Environment.

Specific information on irrigating tobacco is difficult to provide because of variations in rainfall pattern, soil type, temperature and other factors that affect moisture availability and rates at which plants use water. However, there are general guides that are helpful in making the important decisions, such as when to irrigate and how much water to apply.

Tobacco may be irrigated any time during the day or night. Irrigation is more efficient during the night because less water is lost through evaporation and usually there is very little wind.

WHEN TO IRRIGATE

Stage and development of the crop are two important considerations in determining when to irrigate. A slight shortage of moisture between the time the tobacco crop is established and early July is not considered harmful. From early July until topping time (stage of rapid growth), moisture requirements are more critical. Irrigation during harvest is occasionally necessary to promote development of the tip leaves and hasten the maturity of the crop.

The most commonly used method of determining when to irrigate is careful observation of the crop and soil, combined with past experience and the amount of rainfall. Although this method has been reasonably successful, it may indicate the need for irrigation too late to obtain maximum benefits.

A more accurate method involves the keeping of a day-by-day record of the soil moisture supply. Daily moisture use is calculated according to stage of growth and temperatures. When this is combined with an accurate record of rainfall the soil moisture supply can be established. Information on this method may be obtained at the Research Station, Delhi.

HOW MUCH WATER TO APPLY

The objective in irrigation is to saturate the soil to the depth of the main concentration of roots. Therefore the amount of water to apply, when irrigation is necessary, will vary with soil type and time of season.

TABLE 18. WATER mm (MILLIMETRES) TO APPLY WHEN IRRIGATION IS NEEDED

Soil Texture	June		1-7	July			August 1-20
	1-15	16-30		8-14	15-21	22-31	
Sand	8	10	18	23	28	33	38
Loamy Sand	10	13	20	25	33	38	46
Sandy Loam	10	15	23	30	38	46	53

Topping

FLUE-CURED TOBACCO

Time and height of topping have a major influence on tobacco quality and yield. The best time for topping is just after the top has stretched and before any flowers have opened (no later than the stage illustrated on the front cover). Topping all plants, or as many as possible, at the same time, encourages uniform maturity.

Although high topping generally produces more yield than lower topping, maturity of the upper leaves is enhanced by topping so that a good sized tip leaf is produced (about 50 cm in length when full grown). The proper height of topping for maximum quality will vary from one farm or field to another and depends mainly on variety, rainfall distribution, fertility, and time of season. Under average conditions present varieties are capable of producing 17 to 18 leaves.

BURLEY TOBACCO

Burley tobacco like other tobacco types is greatly influenced by time and height of topping. Generally high quality and yield is obtained by topping when 50% of the plants are in extended bud to early flower stage of growth and at 18-20 leaves per plant. This medium topping height produces good mature preferred leaf. Also topping all plants at the same time encourages uniform maturity at harvest. Improved maturity is obtained by harvesting 4 weeks after topping.

SEEDLING PRODUCTION

For more complete information on the production of tobacco seedlings refer to Ontario Ministry of Agriculture and Food Publication 7 *Producing Tobacco Transplants in Ontario*.

MUCK REQUIREMENT - A uniform layer of muck about 5 cm thick is necessary to provide good conditions for seedling growth. Most growers, rather than remove the old muck each year, simply add a small quantity of new muck.

The following table is intended as a guide to the amount required when purchasing new muck.

TABLE 19.

Depth (cm)	m ³ /100m ²	Depth (Inches)	Cubic yards 1000 square feet
1.25	1.25	0.5	1.5
2.5	2.5	1	3.1
3.75	3.75	1.5	4.6
5.0	5.0	2	6.2

SEEDING RATES - The amount of seed required to achieve a good stand of plants (120 per 930 cm²) will vary according to management, type of greenhouse and whether vermiculite is used as a covering after seeding.

Generally the seeding rate without vermiculite should range between 28 g to 165 m² and 28 g to 220 m². Past experience in the particular greenhouse under your own management should be considered in determining the seeding rate. Many growers find that rates in the centre of the range are most satisfactory.

Reduce the seeding rate by 15 to 20% if you plan to use vermiculite as a covering after seeding.

USING VERMICULITE - This material applied as a covering after seeding helps to reduce loss of plants from excess heat and/or dryness and tipping-over.

Several grades of vermiculite are available but you should use only the grade specified for tobacco seedbeds. Sufficient vermiculite should be used to cover but not completely hide the muck surface. One 7 kg bag should cover about 20 m² of seedbed.

Uniform application is essential since plants may not emerge from areas where there is a deep layer of vermiculite (over 1 cm).

As suggested under **Seeding Rates**, 15 to 20% less seed should be used where you plan to use vermiculite immediately after seeding. Vermiculite may be applied later if plant losses to "tipping-over" are excessive.

HARDENING-OFF - Although plants may be hardened through various combinations of moisture stress and greenhouse temperatures, one of the oldest and best methods involves forking and drying the seedbed. Refer to page 15 of OMAF Publication 7 for details on the procedure for "forking".

Normally forking would be done about 2 weeks before planting. Where a mechanical plant puller is to be used seedbeds should be forked about 3 weeks before the start of planting.

STORING FLUE-CURED TOBACCO

The main problems in storing tobacco for any length of time, and especially from one year to the next, are damage from various molds, and heating. Insects are not likely to be a problem but preventive measures need to be taken against rats and mice.

Spoilage is caused by excess moisture either in the tobacco from the start of, or taken up during, the storage period. To minimize the risk of spoilage, tobacco should be packed on the dry side (less than 18% moisture). Also some form of protection needs to be provided such as plastic over and under the tobacco to reduce the affect of variations in moisture in the surrounding air. In most cases facilities are not available to completely eliminate the affects of variations in humidity so periodic thorough inspections are essential. Inspections should be most frequent during and after prolonged periods of mild, damp weather in the fall and spring.

Although trashy grades from lower stalk positions are more prone to spoilage, any type of tobacco may be affected under favourable conditions. Tobacco tends to darken in storage and certain grades such as bright and green may actually improve.

The possibility of spoilage will depend not only on the tobacco and its moisture content but also on the location and type of storage facility. Kilns or barns located on well-drained soil where surrounding air movement is not hampered by trees, hills or other buildings, should offer the safest storage. The capability of providing ventilation after periods of high humidity could be beneficial.

Tobacco in most standard kilns is exposed to wide variations in humidity. This may cause excessive darkening. Considerable damage from various molds may also occur on the lower tiers. For these reasons tobacco should be removed from standard kilns and either sorted and baled or piled in the packbarn.

Bulk kilns on cement pads can provide reasonably safe storage conditons for tobacco in racks, bins or bales but certain precautions need to be taken. Spoilage can occur and is most likley in the bottom tier of racks because of damp conditions close to the cement. Insulated pads should provide drier conditions. Frequent inspection is essential to note any increase in moisture and provide drying conditions when necessary. Exhaust vents should be tightly sealed to prevent any intake of rain or snow.

If bales are stored on the floor of bulk kilns a plastic vapor barrier on the floor should be used. As a further precaution, bales could be stored on top of empty racks installed on the bottom tier.

Bales should not be packed tightly and preferably no more than 2 high in storage. Damp conditions near cement floors in the packbarn or bulk kilns can cause spoilage of tobacco nearest the cement. In the packbarn tobacco should be stored on pallets with a plastic vapor barrier between the tobacco and cement. Plastic could be laid on the cement floor with the pallet on top or on the pallet in which case it would be wise to provide some air circulation between the tobacco and plastic by means of boards, sticks or corrugated cardboard. The plastic vapor barrier is a good precaution even in those barns where plastic has been laid under the cement. If bale stacker or other means of storing the tobacco at a considerable distance above the floor are available the plastic vapor barrier would not be needed. Covering the bales or piles with black plastic will provide some protection from variations in humidity and other conditions that may cause a reduction in quality.

GENERAL INFORMATION

TABLE 20. SEEDING RATES

	kg/ha
Winter Wheat	100 - 130
Rye - Small seeded	70 - 95
- Large seeded	120 - 160
Triticale (OAC Wintri)	75 - 100

SPRAYER CALIBRATION

Here is a simple method of determining the number of litres of spray material being applied to a hectare.

1. Set out two stakes 100 m apart.
2. Pick a level spot and fill the sprayer tank with water. Operate the sprayer to be sure that the supply line up to the shutoff valve is full before finally filling the tank. **RECORD THE WATER LEVEL ON A MEASURING STICK.**
3. Spray between stakes in one direction only at a **DEFINITE SPEED AND PUMP PRESSURE.** Turn the boom on as the first stake is passed, and turn the boom off as the second stake is passed. The by-pass pressure relief valve must be set to give the desired pressure when the shutoff valve is open. **MARK THE THROTTLE SETTING.**
4. Return the sprayer to the same location as before the calibration run. Carefully measure the amount of water required to refill the tank to the same mark on the measuring stick.
5. Calculate the application rate in L/ha using this formula:

$$\frac{\text{litres of water added} \times 100}{\text{boom length (in metres)}} = \text{L/ha}$$

SAMPLE CALCULATIONS Overall Spraying: If the sprayer has a 5.35 m boom and 12 L of water are required to refill the tank, the application rate is:

$$\frac{12 \times 100}{5.35} = 224 \text{ L/ha}$$

Band Spraying: if the sprayer has 4 nozzles and each nozzle covers a 25 cm band, the total width of the spray patterns (boom length) is:

$$4 \times 25 = 100 \text{ cm or 1 m}$$

If 2.5 L of water is required to refill the tank, the application rate is:

$$\frac{2.5 \times 100}{1} = 250 \text{ L/ha}$$

When band spraying, the acreage actually sprayed is NOT the same as the crop acreage. The herbicide rates given in this publication are based on the acreage actually sprayed.

WATER TANK CAPACITY

$$\text{Capacity in litres} = \frac{\text{Volume in cc (cubic centimetres)}}{1,000}$$

To find the volume of:

1. Round tank with flat bottom and top $3.14 \times (\text{radius in cm}) \times \text{height in cm}$.
2. Rectangular tank
Length in cm x width in cm x height in cm

REFERENCES FOR FURTHER INFORMATION

Publications available from the Communications Branch, Ontario Ministry of Agriculture and Food, Legislative Buildings, Toronto M7A 1A5:

7 Producing Tobacco Transplants in Ontario
75 1984 Guide to Chemical Weed Control

Factsheets - *Soil Acidity and Liming*
Winter Wheat in Ontario
Air Pollution and Horticultural Crops
Blue Mold of Tobacco
Tobacco Irrigation with Gun Sprinklers
Tobacco Irrigation with Travelling Gun Sprinklers
Culture of Tobacco Seedlings in Todd Cells

Publications available from Information Division, Agriculture Canada, Ottawa:

1641 *Tobacco Diseases*
1415 *Control of Nematodes in Flue-cured Tobacco in Ontario*
1312 *Curing Flue-cured Tobacco*
1217 *Curing of Cigarette Burley Tobacco*
1228 *Varieties of Burley Tobacco for Southwestern Ontario*

Publications available from the Ontario Ministry of the Environment, Field Office.

Personnal Protective Equipment for Pesticide Users
Chemical Safety Handbook
Pesticides Act and Regulations
Chemical Storage Signs
Aluminum Phosphide for Groundhog Control

CROP INSURANCE

The Government of Ontario, in cooperation with the Federal Government and through the Crop Insurance Commission of Ontario, offers crop insurance protection for tobacco and several other crops. As a result of a Federal Government subsidy of 50% of the premium and with administration costs paid entirely by the Provincial Government, this valuable protection is available to Ontario farmers at less than half the total cost. The premium is also tax-deductible as an operating expense.

Crop insurance offers protection against losses from a broad range of production hazards including hail, frost, flood, drought, wind, excess moisture and/or rainfall, insect damage and disease.

For further information on Crop Insurance for tobacco contact The Crop Insurance Commission of Ontario, Ministry of Agriculture and Food, Legislative Buildings, Toronto, Ontario M7A 1B7 or the area office at the Research Station, Delhi N4B 2W9, telephone (519) 582-3517.

1984 TOBACCO PRODUCTION

RECOMMENDATIONS

ACKNOWLEDGMENTS

The recommendations contained in this publication have been prepared in consultation with:

- Ontario Crop Protection Committee
- Ontario Soil Management Research Committee
- Ontario Weed Committee
- Ontario Tobacco Committee

and personnel of

- Plant Industry Branch, Ontario Ministry of Agriculture and Food
- Agriculture Canada
- Ridgetown College of Agricultural Technology
- Ontario Agricultural College, University of Guelph
- Ontario Ministry of the Environment
- Ontario Ministry of Labour
- Health and Welfare Canada

**ONTARIO MINISTRY OF THE ENVIRONMENT
PESTICIDES CONTROL FIELD OFFICES**

Counties	Field Offices	Telephone
Central Region		
Halton, Peel, York, Durham, Toronto	T. O'Neill and D. Trenholm 150 Ferrand Dr., Suite 700, Don Mills, Ont. M3C 3C3	416-424-3000 (Ext. 204)
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier 139 George St. N., Peterborough, Ont. K9J 3G6	705-743-2972
Simcoe, Muskoka	W. Cowie 12 Fairview Rd., Barrie, Ont. L4N 4P3	705-726-1730
West Central Region		
Haldimand, Norfolk, Niagara, Hamilton, Wentworth	J. Percy Ontario Government Building, 119 King St. W., Hamilton, Ont. L8N 3Z9	416-521-7640
Dufferin, Wellington, Waterloo Brant	R. Miller Ontario Government Building 119 King St. W., Hamilton, Ont. L8N 3Z9	416-521-7640
Southwestern Region		
Elgin, Middlesex, Oxford	D.C. Morrow and W. Lampman 985 Adelaide St. S., London, Ont. N6E 1V3	519-681-3600
Essex, Kent, Lambton	H.E. Collins P.O. Box 237, 435 Grand Ave. W., Chatham, Ont. N7M 5K3	519-352-5107
Bruce, Grey, Huron, Perth	B.T. Lobb 20 King St., P.O. Box 688 Ontario Ministry of Agriculture & Food Building, Clinton, Ont. N0M 1L0	519-482-3428
Southeastern Region		
Frontenac, Hastings, Lennox and Addington, Prince Edwards, Leeds and Grenville	D.A. Raddon 133 Dalton St., Box 890 Kingston, Ont. K7Z 4X6	613-549-4000
Prescott and Russell, Renfrew, Stormont, Dundas and Glengarry Ottawa-Carleton, Lanark	R.P. Cameron 2378 Holly Lane, Suite 204 Ottawa, Ont. K1V 7P1	613-521-3450

Northeastern Region

Manitoulin, Nipissing, Parry Sound, Sudbury	D.J. Mewett Northgate Shopping Centre, 1500 Fisher St., North Bay, Ont. P1B 2H3	705-476-1001
Cochrane, Timiskaming, Algoma	P. McCubbin 83 Algonquin Blvd. W., Timmins, Ont. P4N 2R4 Sault Ste. Marie	705-264-9474 705-949-4640

Northwestern Region

Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building, Thunder Bay "F", Ont. P7E 6E3	807-475-1305
Head Office	Pesticides Control Section 135 St. Clair Ave. W., Suite 100 Toronto, Ont. M4V 1P5	416-965-2401

METRIC EQUIVALENTS

Length

inch	=	2.54 cm = 25.4 mm
foot	=	0.30 m
yard	=	0.91 m
mile	=	1.61 km

Volume (liquid)

fluid ounce (Imp.)	=	28.41 mL
pint (Imp.)	=	0.57 L
gallon (Imp.)	=	4.55 L
gallon (U.S.)	=	3.79 L

Area

square foot	=	0.09 m ²
square yard	=	0.84 m ²
acre	=	0.40 ha

Weight

ounce	=	28.35 g
pound	=	453.6 g
ton	=	0.91 tonne

Volume (dry)

cubic yard	=	0.76 m ³
bushel	=	36.37 L

Pressure

pound per square inch	=	6.90 K Pa
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THE METRIC SYSTEM

Linear Measures (length)

10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)

100 m x 100 m = 10,000 m² = 1 hectare (ha)
100 ha = 1 square kilometre (km²)

Cubic Measures (volume)

Dry Measure

1000 cubic millimetres (mm³) = 1 cubic centimetre (cm³)
1,000,000 cm³ = 1 cubic metre (m³)

Liquid Measure

1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight Measures

1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Weight - Volume Equivalents

(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Dry - Liquid Equivalents

1 cm³ = 1 mL
1 m³ = 1000 L

CONVERSION TABLES - METRIC TO IMPERIAL
(approximate)

Length

1 millimetre (m) = 0.04 inch
1 centimetre (cm) = 0.40 inch
1 metre (m) = 39.40 inches
1 metre (m) = 3.28 feet
1 metre (m) = 1.09 yards
1 kilometre = 0.62 mile

Volume (liquid)

1 millilitre (mL) = 0.035 fluid ounce
1 litre (L) = 1.76 pints
1 litre (L) = 0.88 quart
1 litre (L) = 0.22 gallon (Imperial)
1 litre (L) = 0.26 gallon (U.S.)

Weight

1 gram (g) = 0.035 ounce
1 kilogram (kg) = 2.21 pounds
1 tonne (t) = 1.10 short tons
1 tonne (t) = 2205 pounds

Pressure

1 kilopascal (kPa) = 0.15 pounds/square inch

Proportion

1 litre per hectare = 14.24 fluid ounces per acre
1 kilogram per hectare = 14.50 ounces per acre
1 kilogram per square centimetre = 14.23 pounds per square inch
1 hectolitre per hectare = 1.10 bushels per acre

Area

1 square centimetre (cm²) = 0.16 square inch
1 square metre (m²) = 10.77 square feet
1 square metre (m²) = 1.20 square yards
1 square kilometre (km²) = 0.39 square mile
1 hectare (ha) = 107,636 square feet
1 hectare (ha) = 2.5 acres

Volume (dry)

1 cubic centimetre (cm³) = 0.06 cubic inch
1 cubic metre (m³) = 1.31 cubic yards
1 cubic metre (m³) = 35.31 cubic feet
1000 cubic metres (m³) = 0.81 acre-foot
hectolitre (hL) = 2.8 bushels

Speed

1 metre per second = 3.28 feet per second
1 metre per second = 2.24 miles per hour
1 kilometre per hour = 0.62 mile per hour

Temperature

$^{\circ}\text{F} = (^{\circ}\text{C} \times 9/5) + 32$
 $^{\circ}\text{C} = (^{\circ}\text{F} - 32) \times 5/9$

Application Rate Conversions (Metric to Imperial - Approximate)

litres per hectare x 0.09	=	gallons per acre
litres per hectare x 0.36	=	quarts per acre
litres per hectare x 0.71	=	pints per acre
millilitres per hectare x 0.015	=	fluid ounces per acre
grams per hectare x 0.015	=	ounces per acre
kilograms per hectare x 0.89	=	pounds per acre
tonnes per hectare x 0.45	=	tons per acre

Dry Weight Equivalent

Grams, Kilograms/Hectare

Approximate Ounces, Pounds/Acre

100 grams	=	1-1/2 ounces
200 grams	=	3 ounces
300 grams	=	4-1/4 ounces
500 grams	=	7 ounces
700 grams	=	10 ounces
1.10 kilograms	=	1 pound
1.50 kilograms	=	1-1/4 pounds
2.00 kilograms	=	1-3/4 pounds
2.50 kilograms	=	2-1/4 pounds
3.25 kilograms	=	3 pounds
4.00 kilograms	=	3-1/2 pounds
5.00 kilograms	=	4-1/2 pounds
6.00 kilograms	=	5-1/4 pounds
7.50 kilograms	=	6-3/4 pounds
9.00 kilograms	=	8 pounds
11.00 kilograms	=	10 pounds
13.00 kilograms	=	11-1/2 pounds
15.00 kilograms	=	13-1/2 pounds

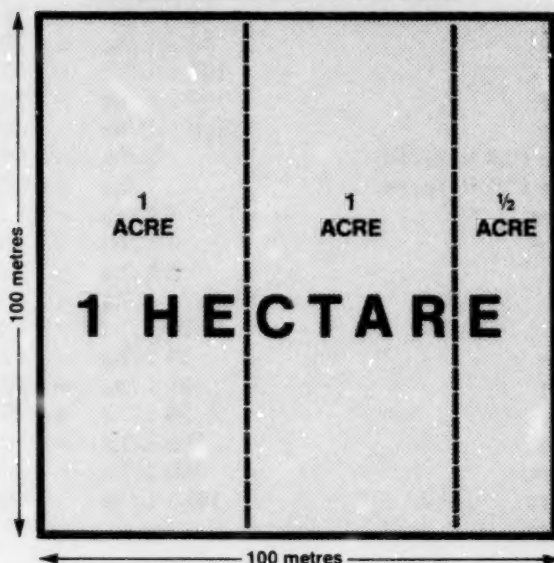
Liquid Equivalent

Litres/Hectare

Approximate Gallons/Acre

50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

ACRES BECOME HECTARES



$$100 \text{ m} \times 100 \text{ m} = 10,000 \text{ m}^2 = 1 \text{ hectare (ha)}$$

HECTARES TO ACRES

1 hectare	=	2.5 acres
2 hectares	=	5.0 acres
3 hectares	=	7.4 acres
4 hectares	=	10.0 acres
5 hectares	=	12.4 acres
6 hectares	=	15.0 acres
7 hectares	=	17.3 acres
8 hectares	=	20.0 acres
9 hectares	=	22.2 acres
10 hectares	=	25.0 acres
20 hectares	=	50.0 acres
30 hectares	=	74.0 acres
40 hectares	=	100.0 acres
50 hectares	=	123.5 acres

ACRES TO HECTARES

1 acre	=	0.4 hectares
2 acres	=	0.8 hectares
3 acres	=	1.2 hectares
4 acres	=	1.6 hectares
5 acres	=	2.0 hectares
6 acres	=	2.4 hectares
7 acres	=	2.8 hectares
8 acres	=	3.2 hectares
9 acres	=	3.6 hectares
10 acres	=	4.0 hectares
20 acres	=	8.0 hectares
30 acres	=	12 hectares
40 acres	=	16 hectares
50 acres	=	20 hectares
60 acres	=	24 hectares
70 acres	=	28 hectares
80 acres	=	32 hectares
90 acres	=	36 hectares
100 acres	=	40 hectares

METRIC APPLICATION RATES WITH AN ACRE PERSPECTIVE

Dry Weight

10 g/ha	=	4 g/acre
20 g/ha	=	8 g/acre
30 g/ha	=	12 g/acre
40 g/ha	=	16 g/acre
50 g/ha	=	20 g/acre
100 g/ha	=	40 g/acre
500 g/ha	=	200 g/acre
1000 g/ha	=	400 g/acre
1 kg/ha	=	400 g/acre (0.4 kg/acre)
2 kg/ha	=	800 g/acre (0.8 kg/acre)
3 kg/ha	=	1.2 kg/acre
4 kg/ha	=	1.6 kg/acre
5 kg/ha	=	2 kg/acre
10 kg/ha	=	4 kg/acre
20 kg/ha	=	8 kg/acre
30 kg/ha	=	12 kg/acre
40 kg/ha	=	16 kg/acre
50 kg/ha	=	20 kg/acre
100 kg/ha	=	40 kg/acre
500 kg/ha	=	200 kg/acre
1000 kg/ha	=	400 kg/acre
1 tonne/ha	=	400 kg/acre

Liquid Volume

10 mL/ha	=	4 mL/acre
20 mL/ha	=	8 mL/acre
30 mL/ha	=	12 mL/acre
40 mL/ha	=	16 mL/acre
50 mL/ha	=	20 mL/acre
100 mL/ha	=	40 mL/acre
500 mL/ha	=	200 mL/acre
1000 mL/ha	=	400 mL/acre
1 L/ha	=	400 mL/acre (0.4 L/acre)
2 L/ha	=	800 mL/acre (0.8 L/acre)
3 L/ha	=	1.2 L/acre
4 L/ha	=	1.6 L/acre
5 L/ha	=	2 L/acre
10 L/ha	=	4 L/acre
20 L/ha	=	8 L/acre
30 L/ha	=	12 L/acre
40 L/ha	=	16 L/acre
50 L/ha	=	20 L/acre
100 L/ha	=	40 L/acre
500 L/ha	=	200 L/acre
1000 L/ha	=	400 L/acre

